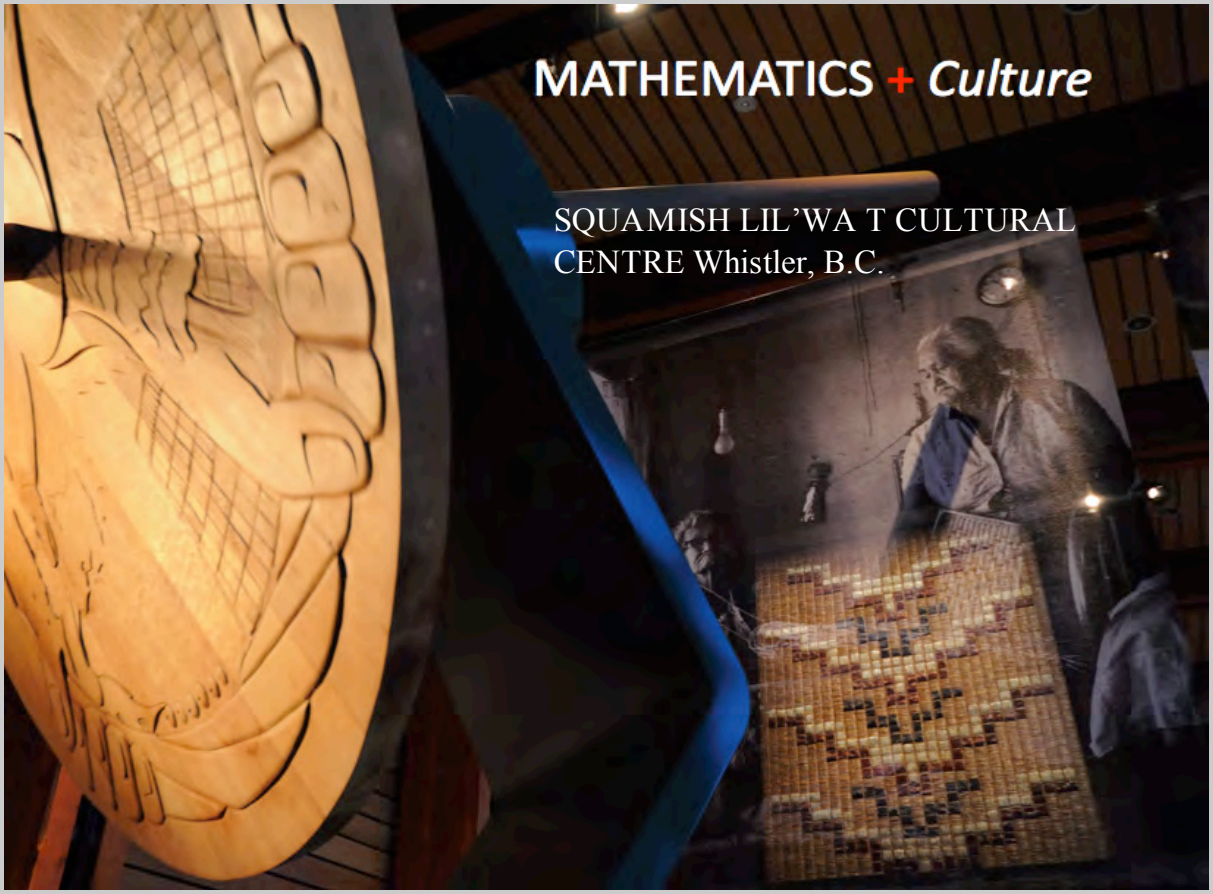

MATHEMATICS AND CULTURE WORK BOOKLET

Developed for the Northwest Mathematics Conference, Whistler, 2009
Kanwal Singh Neel and John Pusic

This booklet contains resources designed to assist teachers and students to explore mathematic and culture through the lens of the Squamish Lil'Wat Nations.

Included are themes such as:

- Cultural / Eco-Tourism
- Paintings and Petroglyphs
- Designing and Building a Canoe
- Weavers at Work
- Beadwork
- Lil'Wat Pit House
- Logos
- Weaving Blankets.
- Carving Totem Poles
- Drums and Drumming
- Making Masks
- Squamish Longhouse

Each theme is connected to BIG IDEAS in Mathematics and questions are provided to promote mathematical conversations. Additionally, space is provided for notes and reflections.

Cultural/Eco-Tourism

In recent years, the fishing and forestry industry has experienced a downfall, and Cultural/Eco-tourism has thus become a major part of the Nation's economy. Cultural/Eco-tourism is a nature-based or cultural travel experience that conserves the ecosystem and respects local culture and traditions. Cultural/Eco-tourism requires problem-solving and analytical thinking skills to conserve the biodiversity of the natural environment when using outdoor recreational areas.

BIG IDEAS:

- Patterns represent identified regularities based on rules describing the patterns' elements.
- Shapes can be classified by identifying their geometric properties i.e. type of side, type of symmetry, type of size.
- Standard units, estimates and measurement formulas are used to simplify communication about or calculation of measurements.

Mathematical Conversations…

- In what ways is can you see math in these images?
- Choose two patterns in the photos above and compare them. How are they similar and different?
- Create or choose at least two patterns and design and sketch your own snowboard or blanket.

Notes and Reflections…

The Logo…"where rivers, mountains and people meet."

The logo represents a shared journey of the two Nations. The red color represents a traditional paint made from a natural source which was used in art, healing, and spirituality. The stepped geometric pattern, found on many Lil'wat baskets, reflects the mountains and valleys of our Interior Salish Nation. The "Salish eye" shape represents the watchful eyes of past and future generations. It adorns Squamish carvings such as those found on paddles and hulls of the magnificent seagoing canoes of Coastal Salish Nation. These two shapes are brought together in a circle representing a spindle whorl, a tool used by both Nations to spin mountain goat wool for weaving.

BIG IDEAS:

- Geometric transformations provide a framework for artistic representation.
- Shapes of different dimensions and their properties can be described mathematically.
- Logical patterns exist and are a regular occurrence in mathematics. Patterns are found in physical and geometric situations as well as in numbers.
- Shapes can be moved in a plane or in space. These changes can be described in terms of translations (slides), reflections (flips), and rotations (turns).

Mathematical Conversations…

- How would you explain the pattern in the logo using mathematical language?
- How are logos and crests linked to the sense of identity?
- How do you think the logo incorporates idea of rivers, mountains and people meeting?
- Search the internet for other First Nation logos. How do they compare to the Squamish Lil'wat logo?
- What shape do most Aboriginal logos form? Explain.
- Imagine you are entrusted with the task of creating a new logo for the Squamish Lil'wat Nation. What mathematics will you need in order to create your logo?

Notes and Reflections…

Rock Paintings or Petroglyphs

Rock paintings or petroglyphs were created, carved, and drawn on the surfaces of caves, cliffs and rocks by the ancestors as guide maps for the people. They illustrated events such as wars, natural disasters, mythology, and transformations. In recent years these paintings are being researched with the following mathematical principles: 1) iteration, 2) recursion, 3) similitude, 4) tiling, and 5) symmetry.

BIG IDEAS:

- Shapes can be moved in a plane or in space. These movements can be described in terms of translations (slides), reflections (flips), and rotations (turns).
- Shapes can be classified by identifying their geometric properties i.e. type of side, symmetry and size.
- Any pattern can be represented in a variety of ways.
- Algebraic symbols are used to represent and analyze mathematical situations and structures.

Mathematical Conversations…

- Which images have a line of symmetry? How do you know?
- Tell the story of the Petroglyphs depicted above.
- Create your own Petroglyph using some of the mathematical principles listed above.

Notes and Reflections…

Weaving Blankets

Woven blankets were traditionally used to protect the wearer, now they are mostly used for ceremonial purposes. The designs on the blanket tell the story of the weaver. Twill weave is used to make diagonal and diamond designs. Twine weave technique completely covers the warp (vertical) threads with the weft (horizontal) threads. The warp strips are first arranged in a vertical direction, and then the weaving is begun by putting the weft strip over and under the warp strip, one at a time. Some blankets have vertical and horizontal symmetry, while others are asymmetric, with the top and bottom having different geometric shapes.

BIG IDEAS:

- Visualization, spatial reasoning, and geometric modeling can be used for two-dimensional representations and solve problems.
- Shapes can be seen from different perspectives.
- Transformations are imbedded in the design of blankets, and other art in many different cultures, including the Squamish Blanket.
- Combining or dissecting other shapes can create any 2-D shape.
- Shapes can be classified by identifying their geometric properties i.e. type of side, symmetry and size.

Mathematical Conversations…

- In what ways are some of the shapes in the weavings the same? Different? How does knowing this help the weaver?
- How would life be different if there were no transformations?
- Think about the ratio of red to white thread in the blanket above? What percentage of each thread is used?
- How could the weaver adjust the pattern if they had significantly less red thread than white? How will this affect the overall design?
- Blanket design requires solid knowledge of patterns and symmetry. What evidence do we have of this knowledge in the photos above?

Notes and Reflections…

Designing and Building a Canoe

Canoe builders use models to obtain accurate measurements that they transfer, to scale, when building larger canoes. Builders rely on their experiences to become proficient at measuring angles, using ratio and proportion, to solve problems involving the scale, similarity, and derived measurement. Their size depends on whether it will be used in the ocean or rivers and lakes. Paddles also come in many shapes and sizes designed for various water conditions and uses, depending on the style of the canoe being paddled. The Salish hunting canoe in the Great Hall was carved from a single cedar tree; it is almost twice the height of the ceiling. The canoe must be removed from exhibition each year and taken on a journey in the ocean to honor the spirit of the canoe.

BIG IDEAS:

- Meaningful measurement and estimation of measurements depend on a personal familiarity with the unit of measure being used.
- It is important to understand how measurement instruments work so that they can be used correctly and meaningfully.

Mathematical Conversations…

- Other than using a metre stick, how else might you measure the dimensions of the canoe or the paddle so that others can also get the same measurements?
- Canoe builders start by determining the width and length of the canoe they want to build. What other measurements do you think are important in the construction of a canoe? List as many as possible.

Notes and Reflections…

Weaving Baskets

Basket weaving is a traditional art form of the Lil'wat people. It provides protective cradles for babies as they begin their lives. Clothing, artwork, ceremonial regalia, food gathering vessels, and shelter are weaved with Cedar roots and barks. The bark and roots are used for baskets, hats, cradles, and many other functions. Entire cedar trees are used to make canoes, houses, ceremonial regalia, treasure boxes, and many other artifacts. Most hats or other artifacts are woven into symmetrical patterns. Symbolic patterns are created to represent the spirits of things, both tangible and intangible.

BIG IDEAS:

- Shapes can be seen from different perspectives. There are many representations of 2-D shapes.
- Patterns are found in physical and geometric situations as well as in numbers.
- Meaningful measurement and estimation of measurements depend on a personal familiarity with the unit of measure being used.

Mathematical Conversations…

- How might the Lil'wat people know what size to make their baskets?
- Without measuring, how would you explain the dimensions of the baskets?
- The baskets are weaved from cedar roots and bark. How could you determine how much bark is necessary to create a single basket?
- Analyze the patterns created in weaving the baskets. What requirements exist in order to ensure that the basket maintains its structure?

Notes and Reflections…

Carving Totem Poles

Carving totem poles requires integration of the art formline, which entails mathematical concepts of proportion, scale drawing, and composition. Ovoids and U-shapes, or their variations, can be reduced, stretched, enlarged, or elongated to fit to a space or to depict certain details. The use of positive and negative space creates tension and balance.

BIG IDEAS:

- Combining or dissecting other shapes can create any 2-D shape.
- Shapes can be classified by identifying their geometric properties i.e. types of side, symmetry and size.
- Tools, units of measure, and degree of precision must be appropriate to the purpose and context.

Mathematical Conversations…

- What are some considerations about shapes and sizes that are required when creating a design for a totem pole?
- Use the internet to find a photo of a Totem Pole. Draw a sketch of the totem pole and answer the questions below:
- How many segments would the carver have divided the original log into?
- Does the design include any overlap between segments? If so, is this consistent for all segments?
- What shapes do you see in the totem pole? Identify as many as possible.
- Discuss the symmetry of the totem pole.
- Pretend that you are a carver.
- Describe the process from start to end of creating a totem pole.
- Create your own sketch or scale drawing of a totem pole.

Notes and Reflections…

Fishing

Knowledge of when to fish, how to fish, and where to fish, determines the amount of fish that will be caught. A fish weir uses a variety of measurements, especially for making nets. Since fish species are of different sizes, the nets are made of different mesh sizes.

BIG IDEAS:

- Understanding measurable attributes of objects assists in the processes of measurement
- Estimation of measures and the development of personal benchmarks for frequently used units of measure help students increase their familiarity with units, prevent errors in measurements, and aid in the meaningful use of measurement.

Mathematical Conversations…

- Explain what considerations are involved in determining the size when building a fish weir.
- How far apart you would tie the sticks / slats for the weir if you didn't have a ruler?
- Plan and design your own fish weir. Draw a sketch of your design and answer the following questions:
- What are you fishing for?
- How far apart would you tie the sticks/slats?
- How large of a weir do you wish to have? What shape will it form?
- How many sticks/slats will you need? (remember to take the opening into account)
- How deep will the water that it sits in be?
- How long should the sticks/slats be?

Notes and Reflections…

Weavers at Work

The Lil'wat are particularly known for their craftsmanship and their unique basket weaving patterns. Cherry bark is used for decorative designs. The red color indicates that it has been used in its natural form, and the black color comes from soaking the cherry bark in a slough for up to a year to absorb minerals from the water. Canary grass is also harvested, soaked, dried, flattened, and split for use as a design feature. This design shows the reflection of the mountain in the water. The five small diamonds represent where the people met to trade goods and socialize.

BIG IDEAS:

- Mathematical thinking and ideas can be organized and consolidated through communication.
- Representations can be used to model and interpret physical, social, and mathematical phenomena.
- Shapes can be seen from different perspectives. There are many representations of 2-D shapes.
- Combining or dissecting other shapes can create any 2-D shape.
- Shapes can be moved in a plane or in space. These changes can be described in terms of translations (slides), reflections (flips), and rotations (turns).

Mathematical Conversations…

- Describe the pattern in the weave in mathematical terms.
- What does a pattern look like that has been created using translations?
- What is the result when a shape is translated twice?
- Consider one of the weaves above. Which colour(s) is more prominent in the weave's design? How is this balance affected by the symmetry of the design.

Notes and Reflections…

Drums and Drumming

Drums have a deep-rooted history and are inseparably connected with the Lil'wat Nation. They are the heartbeat of the Nation. The thunder of the drums and the strength of the voices unite the community. Drumheads are made in various shapes, but most are circular and have a cedar base. The frequency at which the drumhead vibrates, depends on its shape and size. The pitch may also vary, depending on the tension and the assemblage of the drum back. Some drum beats are determined by the way in which traditional songs are sung.

BIG IDEAS:

- Patterns represent identified regularities based on rules describing the patterns' elements.
- Patterns can be represented in a variety of ways. Patterns underlie mathematical concepts and are found throughout the real world.

Mathematical Conversations…

- Drums can be made in many different shapes. What shapes do you think are being used for the drums in the photos above?
- Discuss why drums are usually a round shape and not square or triangular?
- How would you find the perimeter of a drum (circular, six-sided, eight sided)?
- What different kinds of patterns can you find about the drum.
- Drumming also involves patterns of sound and counting of beats. Imagine the sound of drumming and develop a mathematical way of representing that sound to share with a classmate.

Notes and Reflections…

Beadwork

Beadwork artists usually draw out the pattern and shape on a graph paper and then transfer it. Number operations, ratios and fractions are used as the number of beads of one color is compared to the total number of beads. Measurement, using standard and nonstandard units, is also used in beadwork. The four kinds of transformations can be found in beadwork: reflection through line, rotation, translation, and glide-reflection.

BIG IDEAS:

- Fractional parts are equal-sized portions of a whole or unit. A unit can be an objects or a collection of things.
- The more fractional parts used to make a whole, the smaller the parts.
- Equivalent fractions are ways of describing the same amount by using different-sized fractional parts.

Mathematical Conversations…

- Estimate the fraction for each colour used in the beadwork? How did you do your estimation?
- Create a bead design involving one or more of the following transformations: reflection, rotation, translation, glide-reflection
- Beads assume value depending on their colour and design. Assuming that more colour results in more value, develop a system of attaching a value for a particular beadwork.

Notes and Reflections…

Making Masks

Art and artifacts are representative of a way of life. Jewellry, masks and other forms of art are ways of visualizing the culture. The masks were worn during potlatch ceremonies to represent the spirit beings encountered by their ancestors. The carvers show a highly developed sense of three-dimensional form and space.

BIG IDEAS:

- Shapes can be seen from different perspectives. There are many representations of 2-D and 3-D shapes.
- Shapes can be classified by identifying their geometric properties i.e. type of side, symmetry and size.
- Use of various representations can help understand the effects of simple transformations and compositions.

Mathematical Conversations…

- How are symmetry and knowledge of the properties of shapes used in carving a mask?
- Draw or describe some shapes that look the same after they have been transformed.
- Tell the story that lies behind the mask.
- Draw a sketch of one of the masks above and draw all the lines of symmetry on your sketch. Check your lines by folding.
- Consider the patterns found on the masks above. What measurements will the carver have to have done in order to create the mask?

Notes and Reflections…

Traditional Squamish Longhouse (Tl'aktaxen Lam)

The Longhouse, with its single sloped roof, was the traditional communal dwelling of the Squamish people. Its engineering was ingenious; cedar planks for the sides and roof were tied to a timber frame with cedar ropes. Because the planks were not permanently attached, it could be assembled, or taken apart, and transported by canoe to seasonal locations.

Lil'wat Pit House (Istken)

The Istken, with its unique cone shaped roof, was the traditional dwelling of the Lil'wat people. A hole was dug in the forest floor, crossed tree branches were placed over the hole and filled with moss to form the roof. It was warm in winter and cool in summer. The main entrance was by a single ladder through the smoke hole in the roof, making it easy to defend. A secondary entrance was built into the side of the Istken, generally hidden from view, where elders and children could enter more easily.

BIG IDEAS:

- Shapes of different dimensions and their properties can be described mathematically.
- Meaningful measurement and estimation of measurements depend on a personal familiarity with the unit of measure being used.
- Relationships between quantities can be described using rules involving variables.

Mathematical Conversations…

- Compare and contrast the two buildings, Longhouse and the Istken, using mathematical language?
- Determine the slope of each roof.
- The design of a longhouse involves an intricate use of varying sizes of logs and slats. Take a close look at the photos above.
- What shapes do you see?
- How are parallel and perpendicular lines represented?
- How do the sizes of the logs work together to make the structure strong?
- Longhouses were built without nails or glue to bind the structure together. How are shapes and design used to avoid the need for binding tools?
- Compare a longhouse with a modern hall built today. How are they alike or different?

Notes and Reflections…

ACKNOWLEDGEMENTS

The Squamish Lil'wat Cultural Centre in Whistler BC, where mountains, rivers and people meet, embodies the spirit of partnership between the Squamish and Lil'wat Nations. The Cultural Centre stands as a testimony to the proud heritage around preserving and sharing traditional cultures - from time immemorial to the present.

This booklet showcases some of the numeracy practices of the Squamish and Lil'wat Nations as found at the Squamish Lil'wat Cultural Centre in Whistler BC. The cultures of these Nations are grounded in rich, ancient traditions, and continue to grow and evolve in a modern world. The problems they solve are contextual and situated within that community, and provide insights into how the people use their knowledge in dealing with the quantitative, relational, and spatial aspects of their lives.

Text compiled by Kanwal Singh Neel and John Pusic. Photos provided by Gary Fiegehen Photography. Special thanks to Selina Millar for her contribution. BIG IDEAS were adapted from Van de Walle, J. and Lovin, L.H. (2006) Teaching Student-Centered Mathematics Grades 5-8. Boston, MA: Pearson Education.

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